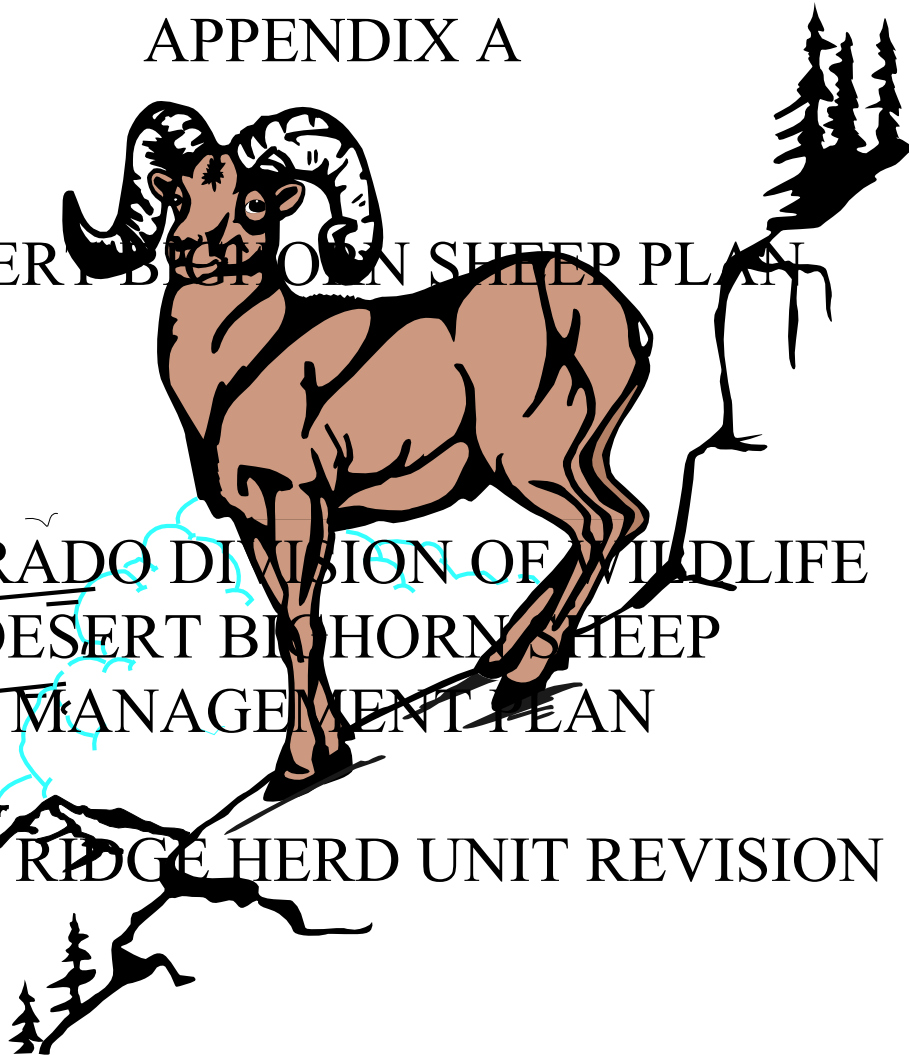


APPENDIX A

DESERT BIGHORN SHEEP PLAN

COLORADO DIVISION OF WILDLIFE
DESERT BIGHORN SHEEP
MANAGEMENT PLAN

BLACK RIDGE HERD UNIT REVISION



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MANAGEMENT PLAN WORKING GROUP MEMBERS

This bighorn sheep management plan herd unit revision was completed in conjunction with a public meeting and through a series of formal working group meetings. The working group for this herd unit was assembled in order to provide suitable input from various public and private groups who were interested in the management of both the bighorn sheep and habitat which the sheep utilize.

The working group will, when necessary, facilitate the implementation of the plan, consider issues as they arise and review progress of the plan's objectives.

The working group was composed of the following individuals.

	<u>Representing</u>	<u>Concurrence and Date</u>
Frank Adams	Rocky Mountain Bighorn Sheep Society	_____
Mary Clarke	Mesa County Woolgrowers Association	_____
Paul Creeden	Colorado Division of Wildlife	_____
Van Graham	Colorado Division of Wildlife	_____
Hawk Greenway	Rancher -- Glade Park area	_____
Warren Gore	Rancher -- Glade Park area	_____
Kathleen Hedlund	Sierra Club, Grand Junction	_____
Ron Lambeth	Bureau of Land Management, Grand Junction	_____
Patrick Perrotti	Colorado National Monument	_____
Roberta Snyder	Glade Park citizens' representative	_____
Cathie Zarlingo	BLM Resource Advisory Council member	_____
Fred Facer	Colorado Mountain Club	_____

Other individuals recognized for their support of the working group include:

David Lehmann	BLM, Grand Junction – facilitator
Judi Lofland	Colorado National Monument, recorder
Robbie LeValley	Colorado State University Extension Service, Delta County
Julie Hansmire	Colorado Woolgrowers Association

Approval:

Catherine Robertson: _____
Grand Junction Resource Area Manager, Bureau of Land Management Date

Steve Hickman: _____
Park Superintendent, Colo. National Monument, National Park Service Date

Jim Olterman: _____
West Region Terrestrial Wildlife Supervisor, Division of Wildlife Date

INTRODUCTION

In 1989 the Colorado Division of Wildlife (CDOW) and the Bureau of Land Management (BLM) approved a restoration management plan for desert bighorn sheep in Colorado (CDOW and BLM 1989). This plan was developed to coordinate the establishment of self-sustaining desert bighorn sheep populations in western Colorado.

The 1989 management plan provided broad management guidelines for its implementation. It established population and habitat management objectives for each sheep herd along with the current land use management decisions, monitoring activities, planned actions and coordinated guidelines with other resource programs.

This plan is a revision of the 1989 management plan for the Devils-Mee Canyon unit, which has been renamed the Black Ridge herd to better define the herd's geographic range. The revised plan is a joint effort of the CDOW, BLM and Colorado National Monument (NPS).

Since the original management plan was completed in 1989, the restoration of desert sheep in the Black Ridge unit has not developed as anticipated. It was anticipated sheep transplanted during the initial reintroductions would populate all suitable range from within the Colorado National Monument to the Colorado state line and support a self-sustaining herd. During the late 1980's and early 1990's, it was determined by CDOW that the population had not extended its range west of Mee Canyon. It also appeared that population numbers were not increasing as predicted. The herd was expected to number about 170 animals by 1995; however, estimates ranged from 50 to 100 sheep in 1995.

Four separate transplants of desert bighorn sheep have been made to establish the herd. Three are considered to be founder herd transplants and took place in 1979, 1980 and 1981. Another transplant took place during October 1995 with the objective of extending the range of the established herd. Initially, efforts were made to transplant sheep from the existing Black Ridge herd. This transplant approach failed when suitable trap sites could not be found. An alternate transplant plan was initiated, which involved trapping and transplanting sheep from another state. A request for sheep was made from CDOW to the Nevada Division of Wildlife. This project included an environmental assessment which was completed by the Grand Junction Resource Area of the BLM for the proposed release. The NPS provided funds for this trap and transplant project.

Additional interest in restoring a desert bighorn sheep population occurred during 1995. The NPS indicated an interest in renewing efforts to establish a herd that would inhabit the Colorado National Monument.

This interest from the CNM, as well as heightened public concern about the desert bighorn herd and its management in the Black Ridge area, confirmed to the agencies involved that it would be appropriate to update this section of the 1989 management plan. It was noted that the plan's development would benefit by more public involvement in the decision-making process.

In October of 1995, action was taken to update the Black Ridge desert bighorn sheep management plan. A desert bighorn sheep working group was formed in order that public interests would be represented in development of the management plan. The working group was composed of various interested individuals who represented a cross section of public and private groups, concerned citizens and landowners. The plan's development would be accomplished in a manner consistent with BLM and NPS rules, guidelines and regulations and would be adopted as a subsection of or an appendix to the BLM Ruby Canyon Management Plan.

This management plan applies only to the desert bighorn population within the identified her unit boundary. If the wild sheep population expands beyond the present boundary, then this plan will not apply to that portion of the population outside the her unit. If this type of expansion occurs, then a revision of this plan or a new plan will be necessary.

BLACK RIDGE HERD STATUS

The current number of desert bighorn sheep in the Black Ridge herd is difficult to determine. Accurately estimating numbers of animals in a free-ranging population is one of the most difficult problems facing wildlife managers. Census techniques are expensive and usually require that a portion of the population be marked in some manner. Often estimates are based on the minimum number of animals known to be alive in a population at a particular time. Minimum numbers may be determined by helicopter sex/age classification surveys and both intensive and extensive ground surveys. The minimum number is simply an enumeration of all the known sheep in the population.

Current estimates for this herd range from 50 to 75 sheep. The population estimates are based on several different indices including classification surveys (helicopter sex and age surveys), aerial and ground counts, and hunter harvest success.

The CDOW conducts classification surveys to obtain information regarding the age and sex structure of the population (Table 1). Surveys are usually conducted by helicopter. This information provides a minimum number of known animals observed during the survey. It also provides data on lamb survival and lamb recruitment into the adult population as well as data on distribution and movements. The sex/age ratios presented in the table are shown as the number of rams and lambs per 100 ewes.

Currently, there is a concern that the Black Ridge desert bighorn population is not growing and expanding its range as anticipated. The short-term objective established in the original management plan in 1989 was to have a population of 170 animals by 1995. This population size has never been reached. Both adult and lamb survival rates are lower than anticipated. The factors that might be influencing this problem are not well known. No widespread disease problems have become evident, although three sheep skulls have been found that showed signs of chronic sinusitis. Predator populations are not known to have markedly increased. However, it has been well documented in the Black Ridge area that mountain lions have preyed on adult sheep in recent years.

Table 1. Desert bighorn sheep classification surveys for the Black Ridge herd.

DATE	CENSUS COUNT	LAMB:EWE RATIO	RAM:EWE RATIO	CENSUS TYPE
1991 0613	54	53.8/100	42.3/100	hel
1993 0623	39	61/100	8.6/100	hel
1994 0922	20	8.3/100	58/100	ground
1994 1012	31	26.7/100	80/100	hel
1995 0620	25	50/100	100/100	hel

BLACK RIDGE HERD UNIT BOUNDARIES

Generally, the Black Ridge desert bighorn sheep herd unit area is bounded on the north by the Colorado River and the canyons draining into the Colorado River from Black Ridge and the northeast boundary of the Colorado National Monument to Little Park Road, on the east and south by Little Park Road, the southwest boundary of the Colorado National Monument and the Black Ridge Divide, and on the west by the Colorado/Utah state line (Figure 1). It includes the entire Colorado National Monument. This management plan pertains only to lands within Colorado due to jurisdictional boundaries, but a small herd of desert sheep exist in Utah immediately west of the Black Ridge herd in the Marble and Star Canyon area.

DESIRED POPULATION SIZE

Goal: The goal is to establish a self-sustaining desert bighorn sheep population which will persist over time within the Black Ridge herd unit. The population should be large enough to ensure genetic diversity within the sheep herd. This diversity should be

enhanced through random individual interchange with other desert sheep populations in both Colorado and Utah. The CDOW, NPS and BLM will coordinate and cooperate with the Utah Division of Wildlife, Utah BLM and NPS Parks in the management of this sheep herd.

Objective: The long-term objective is to manage this herd unit to support a population ranging from 100 to 525 animals.

DESERT SHEEP POPULATION MANAGEMENT OBJECTIVES

Population Size

Management of sheep numbers is essential for long-term survival of the herd. The habitat available for this herd is finite, which limits the maximum number of sheep that can be sustained. Concerns regarding sheep numbers are important with regard to both minimum and maximum numbers.

There is a substantial amount of information available relating to minimum viable population size for wild sheep. If the number of sheep is too low (less than 100), concerns are increased regarding the establishment of a self-sustaining population (Berger 1990). These concerns revolve around genetic diversity and the potential impacts of disease and excessive predation on a small number of animals. Conversely, populations which are too large can adversely impact desired plant community objectives and the domestic livestock industry. Recreational uses would be impacted if the concern for protecting bighorns did not relent commensurately with the increased security of the herd.

Genetic isolation concerns pertain to the level of genetic variation (heterozygosity) in the herd. Low levels of genetic variation may suggest inbreeding is occurring in a population. Inbreeding can result in various types of physiological problems, which are often detrimental to long-term herd survival.

Excessive predation on a small herd, particularly by large carnivores such as mountain lions, can impact the herd's ability to maintain itself. This occurs when annual production in a small herd is unable to keep pace with losses due to predation.

The population objective developed by this plan is a result of both socioeconomic and biological considerations. Some of the socioeconomic considerations include historic uses such as grazing, deer hunting, hiking, horseback riding and other recreational uses, both within and adjacent to the sheep range. Biological considerations relate to the maintenance of healthy vegetative communities and a robust bighorn sheep population. The desired population objective (100-525) reflects a balance between maintaining a viable minimum sheep population and numbers that are too high, which would affect range conditions and other uses.

Minimum population size was determined through a literature review. Symonds and Singer (1995) state that a population of approximately 100 sheep is critical to short-term persistence of a few decades for bighorn sheep. Although, Krausman, et. al. (1993), reports on six populations of less than 50 individuals that persisted for at least 34 years in the southwest United States.

The maximum population number for this herd was determined using several different analytical techniques, the results of which were then assessed to achieve the most appropriate number. BLM data indicate that there is enough forage to support 853 desert sheep (Appendix A-A). This level of use was determined after the forage allocation for domestic livestock had been subtracted from the total available. The BLM used a second method to determine an upper population limit using a habitat suitability rating system developed for desert bighorn sheep. This method indicated a population of 538 sheep could be supported (Appendix B).

The lower population number derived by the two methods was selected as the upper population objective for this herd. This provides a cushion which will serve to further protect vegetation from over utilization.

If populations remain below 50 sheep through a period of five years it will be necessary to reevaluate this plan and the need to continue ongoing management practices.

The maximum population objective of 525 sheep may need to be decreased if monitoring data, including the condition of the vegetative environment, indicate that sheep numbers are exceeding desired forage use levels. Populations will be adjusted to a desirable level through sport hunting on land other than those administered by NPS.

Population Monitoring

This plan recognizes that the herd's population may fall below 100 animals in the future. This will not jeopardize ongoing management practices including population monitoring, habitat management and hunting seasons. Continued active management of this herd will be based on population monitoring data including:

- a. Population size
- b. Recruitment of young into the adult population
- c. Impacts of predation
- d. Incidence of disease problems

Both resident populations and recently transplanted populations will be monitored. Monitoring will be conducted to determine critical biological components that document the viability of the herds. These components include:

1. Reproductive success as measured by both the number of lambs born and survival through the first year of life. Survival to the first year would be termed recruitment into the population.
2. Sex/age ratio data. This would include the number of rams and lambs per 100 ewes.
3. Survival of adult animals. Including average length of survival in years. Documentation of mortality factors, including predator losses.
4. Movements throughout their ranges relative to times of the year.
5. Delineation and documentation of critical ranges including seasonal use areas (spring, summer, fall, winter), lambing areas, breeding sites, migration corridors, avoidance areas (suitable habitat not used), preferred feeding sites, and escape terrain.
6. Annual population estimates based on the best available data.
7. Assessment of human related impacts, including the impact of dogs (see section below).

Sheep monitoring and population assessment will be conducted using several different methods, these include:

1. Monitoring will be conducted by ground and aerial survey. Aerial survey will be conducted by both fixed-wing and helicopter aircraft. CDOW will provide the fixed-winged aircraft. Helicopters will be contracted when needed.
2. Sheep locations will be filed in a computer database. Locations will be kept by the Universal Transverse Mercator mapping system. Other pertinent biological and physical data regarding sighting locations will also be recorded and stored in the database.
3. Intensity of monitoring will vary based on the biological season of the year. Regular monitoring will be conducted to study the survival and condition of each animal. Schedules will be developed so that data necessary to evaluate study requirements are met.
4. Data will be used to update CDOW Wildlife Resource Information System (WRIS) mapping files. Annual reports will be completed documenting results of field studies.
5. Survival, movements, and mortality will be documented using radiotelemetry when collared sheep are available in the population.

Transplants:

The intent is to establish a self-sustaining population rather than maintaining minimum populations through a series of transplants. Transplants will not be used to increase herd size in the event natural herd production is unable to maintain minimum population size. Also, additional data is needed from population monitoring to clarify the criterion for future transplants.

Currently, future transplants will be considered as follows:

1. To extend the range of the herd to encompass the entire desired unoccupied potential habitat (Figure 1) if sheep do not expand naturally on their own. It has been found that bighorn sheep are often poor pioneers because of social bonding that favors use of established areas (Risenhoover et. al., 1988).
2. To ensure increase heterozygosity if genetic testing indicates that it would be advisable to increase genetic diversity.

The BLM and NPS will complete NEPA requirements for all future transplants on public lands in their jurisdiction. Public involvement will remain an important part of this process.

Predation

Recently acquired data indicate that mountain lions may be having a significant impact on the sheep population. Between November of 1995 and May 1996, seven radiocollared sheep died. Field inspection of the carcasses indicated five were killed by mountain lions; one sheep may have been killed by lion and the last died of unknown causes, but was not likely killed by predators. There is also speculation that a significant portion of the lamb mortality may be attributed to predation, but no definite data are available to support this supposition.

Two recently published reports conclude that mountain lion predation can be a significant limiting factor on herd viability (Boyce et. al. 1996, Ross et. al. 1996). In some cases lion predation on bighorn sheep appears to be largely an individual, learned behavior with some individuals preying heavily on sheep.

This information combined with Black Ridge monitoring data may indicate a similar situation with one or several lions that are having a significant impact on the population. Mountain lion harvest in the Black Ridge area is known to be very low. Hunters and outfitters who guide hunters are reluctant to hunt this area due to the difficult terrain and problems this can cause with pursuit hounds. In recent years the annual harvest quota for mountain lion has not been met in CDOW Game Management Unit 40. Since 1990, 57% (31 harvest/54 quota) of the quota has been taken by hunters. In order to encourage harvest and target mountain lion, several possible alternatives will be explored by CDOW (note: hunting is prohibited within Colorado National Monument). These options include:

1. Encourage outfitters to guide hunters on an "old west" horseback hunt. This type of hunt may appeal to a certain category of hunters.
2. Provide incentives to encourage lion hunting in the Black Ridge area by increasing the bag limit to two lions.

3. If monitoring shows that one or a few lions are causing most of the mortality, then target that lion for harvest. This may include special hunts to target specific animals. As part of ongoing monitoring studies, removing specific lions may help in determining if individual lions may be responsible for much of the predation losses.

Conflict resolution domestic/wild sheep concerns

Considerable controversy, throughout the western U.S., revolves around the issue of potential disease interactions between bighorn and domestic sheep. The issue centers around the possibility that domestic sheep may transmit diseases to wild sheep populations resulting in large die-offs of the wild herds. Michael Miller, DVM PhD, and CDOW veterinarian, in a letter to the American Association of Wildlife Veterinarians states:

"Pasteurellosis has long been recognized as an important disease of both bighorn sheep and domestic livestock. A pneumonia complex impairs bighorn populations performance throughout North America, and similar respiratory disease complexes plague both cattle and sheep industries worldwide. The bacteria, Pasteurella spp., play a major role in each of these. Wildlife and agricultural professionals share frustration over inability to completely understand and control these complexes" (Miller 1989).

In light of this potential disease dilemma, current recommendations from most wildlife managers encourage, that where possible, bighorns and domestic should not extensively share habitat. However, Miller (1989) further recommends a conservative approach to co-management of domestic and wild sheep. Due to the considerable amount of uncertainty regarding the aspects of disease interchange, Miller concludes that the extent of conservatism in managing these interactions should be decided by local wildlife and livestock professional on a case-by-case basis.

During the course of the development of this management plan, working group members encountered similar controversy regarding this disease problem. Our approach to this problem evolved in the direction of the recommendations that Miller suggested i.e., we decided to deal with the concerns at a local level and recommended the following actions discussed below.

Currently, there is no domestic sheep grazing within the Black Ridge bighorn herd boundaries or adjoining lands to the south. Most of the BLM grazing allotments on lands within or adjacent to the herd area were voluntarily changed from sheep to cattle by the permittees except the Upper Bench, Battleship and 28 Hole allotments which still authorize sheep grazing. There are no limitations or restrictions which would prevent landowners from changing back to sheep grazing on their private land or on BLM allotments which currently authorize sheep use. On BLM lands that were

converted to cattle, the permittee would have to obtain authorization to change back to sheep. Large portions of the Black Ridge herd area are not grazed by livestock including the CNM (grazing is prohibited within the boundaries of CNM), major canyon bottoms and the benches above Pollock and Flume Canyons.

In order to minimize conflicts which may be detrimental to bighorn sheep, the following actions should be considered in the event domestic sheep are again grazed in close proximity of the Black Ridge herd. These concepts are predicated on cooperative attitudes and open communications between private landowners, NPS, BLM and CDOW.

It has been noted in the past in the Black Ridge area that domestic sheep have been observed to be spatially close to wild sheep and no known mingling has occurred and with no documented adverse impacts to wild sheep.

1. Natural barriers should be used on BLM lands to maintain separation of sheep in the event that domestic sheep grazing is begun in close proximity to the wild sheep. Both topographic and vegetative barriers should be considered. These will be dealt with on case-by-case basis on allotments. Natural barriers include rocky cliffs, ridges, escarpments and vegetation. Dense pinyon-juniper woodlands should be encouraged in border areas where domestic sheep may be grazed. Both natural and prescribed fire should not be encouraged in these areas.
2. Fencing (conventional livestock), in short segments, should be used to augment natural barriers on BLM lands. Extensive segments of conventional fencing, eight foot, or double fencing is considered too expensive to use over the entire Black Ridge herd unit boundary. CDOW may install fencing if there are consistent problems in localized areas. Movements of other species of wildlife, including deer and elk, should be considered prior to fence construction.
3. Grazing permittees would be allowed to change from cattle to sheep on nearby BLM lands provided a management plan or cooperative agreement is adopted by CDOW, BLM, NPS and the permittee to minimize the risk of mingling of wild and domestic sheep. This also applies to trailing of domestic sheep.
4. Aggressive herding should be used to prevent mingling of bighorns and domestic sheep. As an example, Idaho allows herding dogs to deter bighorns in efforts to discourage mingling. Aggressive herding could include extra herding dogs, extra herders or any other herding techniques applied to reduce the possibility of mingling.
5. The purchase of easements may be used in the event that other methods prove unsatisfactory in maintaining separation between wild and domestic sheep.

The CDOW will respond to the presence of bighorn sheep on private land on a case-by-case basis as it applies to potential disease situations. Capture, quarantine and monitoring (including assessment for research information) will be the first priority in

handling situations where there is concern for the welfare of the wild sheep. Euthanasia of wild sheep will be a secondary preference where the health of the entire wild herd may be in jeopardy.

Game damage situations will be handled by the CDOW according to CDOW guidelines.

Recreation conflicts with desert bighorn sheep

Wildlife research and management studies have shown that bighorn sheep can be affected by human use of the environment. Human-wildlife interactions are especially relevant in wilderness areas where resource managers must attempt to provide habitat for species that may be very sensitive to human activities (Hendee et. al., 1990).

In order to avoid impacts detrimental to bighorn sheep, recreational users of the Black Ridge area need information and education regarding wild sheep behavior. Human use of the area may need to be regulated in some manner to further protect sensitive areas.

Additionally, studies (Harris et. al., 1993) have shown that one group in five recreational users was accompanied by dogs in New Mexico. Dogs, by nature, tend to roam extensively when out with recreationists and some may potentially harass or kill wild sheep.

Currently, there are no known areas where direct impact by human use has been detrimental to the Black Ridge bighorn sheep herd. However, recreational use is increasing as people become more familiar with the recreational opportunities that exist in the area.

The amount and intensity of recreational use is important information when evaluating impacts on desert sheep. Additional data should be collected in order to more accurately assess impacts to sheep should they occur. Currently, there are trailhead registration books at Liberty Cap, Monument, Devils and Pollock Canyon trailheads. Data related to recreational use may be collected by the following means:

1. Interested individuals (volunteers)
2. River outfitters
3. CDOW surveys
4. NPS and BLM surveys including additional trailhead sign-in stations
5. Trail and road electronic traffic counters

During this desert sheep planning process specific localities were identified where recreational activities were of concern to desert bighorn populations. Efforts should be

directed at minimizing human disturbance in crucial areas, e.g., lambing, rutting and other seasonal concentration areas.

Implementation of proposed management actions initially will be done through information and education programs. More formal regulations may be necessary if voluntary compliance efforts are unsuccessful.

Informational brochures will be prepared and distributed by CDOW, NPS and BLM which will include information regarding desert bighorn sheep protection, management and viewing. This information on management will be sent to appropriate recreational users including hiking and climbing organizations, professional commercial users, outdoor equipment retailers and at the Glade Park Store. River outfitters will be asked to assist in protecting important desert sheep areas and habitat.

Potential Recreational Conflict Areas

1. Devils Canyon - This area receives approximately 6,000 recreational visits per year. Most of the activity is in the form of recreational hiking (75%). Almost a third of the use occurs during the month of May. There is the potential for commercial recreational rock climbing to occur on the canyon walls. Devils Canyon is used year-round by desert sheep. It is also a known lambing area. Impacts would be to lambing and disruption of the overall use of the canyon by sheep.

Management Direction

- a. Hiking in the main canyon is acceptable. Hikers will be encouraged to hike only as far as the old BLM cabin.
 - b. Hiking in the side canyons will be discouraged, particularly during lambing season from April 1-June 1 each year.
 - c. Rock climbing should be encouraged at alternative sites away from Devils Canyon. Commercial permits for climbing and horseback riding need stipulations for seasonal restrictions--April 1 - June 1 annually for lambing season.
 - d. Installation of information signs at Devils Canyon trailhead and old cabin.
2. Pollock and Flume Canyons - This area receives approximately 5000 recreational visitors per year. Roughly half are mountain bikers, the remaining half are hikers and horseback riders. These canyons are used by bighorn sheep, particularly both forks of Pollock Canyon. Lambing is known to occur in these areas. Concerns are associated with the Pollock Bench bike trail and increased hiking into the canyons.

Management Direction

This area will be monitored to determine if recreational use is at levels which may adversely impact bighorn sheep. If problems occur, then seasonal closures and other management may be necessary.

- a. CDOW remote monitoring of sheep use
 - b. BLM trailhead monitoring station (sign-in trail book) and trail traffic counter
3. Mee Canyon - This remote area is a desirable destination site for hikers due to its unique geological features, including the alcove in the upper portions of the canyon. Desert bighorn sheep inhabit the entire canyon as well as the alcove area. Public use (number of visits) to the alcove site is unknown, but has increased significantly in the last five years. A lack of escape routes above the alcove may limit sheep use if recreational activities are excessive.

Management Direction

The Mee Alcove Trail and signing issues are being addressed in the Ruby Canyon Plan. The management practices included in this plan should be implemented for management of desert bighorn sheep.

4. Rattlesnake Canyon - This canyon is important bighorn sheep habitat. It is both a lambing area and year-round use area.

Management Direction

Construction and maintenance of an information trail sign at the "T" in the road near the heads of Mee and Rattlesnake canyons.

5. Colorado National Monument - Bighorn sheep are often found using western portions of the Monument. Most commonly sheep are observed in Monument, Fruita and Kodels Canyons, as well as along the historic Rim Rock Drive. Visitors are known to get out of their vehicles and disturb wild sheep. This is for the most part unintentional.

Management Direction

Educate visitors through interpretive programs and brochures as to the sensitivity of wild sheep to humans. Encourage visitors to view sheep at appropriate distances and from their vehicles.

HABITAT MANAGEMENT OBJECTIVES

Management of the habitat on Black Ridge is essential for maintenance of the ecosystem. Similarly, habitat management is an important part of maintaining desert sheep populations. Currently, the BLM is in the process of developing a management plan for the Ruby Canyon area, which encompasses most of the Black Ridge desert sheep range. During the development of the Ruby Canyon Plan, desert bighorn sheep habitat concerns and requirements are being considered. Therefore, this desert bighorn management plan will comply with recommendations and decisions developed for habitat management in the Ruby Canyon Plan.

The Ruby Canyon Plan will address but is not limited to road management, desired plant community characteristic, natural fire management, and recreation management.

As wild sheep habitat within Colorado National Monument is being managed as a natural ecosystem, no habitat management improvements are contemplated.

Grazing Management (BLM)

Cattle grazing is one of the many uses occurring in the Black Ridge area outside of Colorado National Monument. During the development of bighorn sheep population objectives, bighorn forage availability was determined after domestic livestock consumption was considered. Grazing management is addressed in allotment management plans developed by the BLM.

Natural Fires

Natural fire, except for bighorn vegetative barriers, will be encouraged on BLM lands as directed in the Ruby Canyon Management Plan. In critical bighorn sheep use areas, increasing the amount of open visual distance in the pinyon-juniper habitat would be a desirable goal. All natural fires are suppressed on Colorado National Monument lands. However, future prescribed fire management plans may amend this policy.

Habitat Improvement Projects

Limited opportunities exist within the National Monument and BLM Wilderness Study area for habitat alteration or augmentation. However, removal of man-made obstacles such as old fences may be appropriate in both areas. Small scale water developments are appropriate for BLM WSAs and two presently exist.

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Appendix A. Estimation of desert bighorn sheep carrying capacity - Method 2

To estimate the carrying capacity of the Black Ridge desert bighorn sheep herd's range, the following publication was used:

Armentrout, D.J., and W.R. Brigham. 1988. Habitat Suitability Rating System for Desert Bighorn Sheep in the Basin and Range Province. BLM Technical Note 384. 18pp.

The method considers 10 habitat variables to derive a factor that rates the quality of the range. This factor used with size of the range and the estimated density of bighorns on the best ranges yields the estimated carrying capacity of the range. The rating system was modified by using the arithmetic mean of the weighted variables, called Weighted Indices (WIs), instead of using the geometric mean. The concept of the geometric mean is that the habitat suitability rating factor must be less than its weakest WI. This negates the weight of the other habitat variables. This seems extremely conservative and would imply that the existing herd is impossible.

The following habitat variable and the scores are averages for the existing and designated potential range of the Black Ridge herd of desert bighorn sheep.

Suitability Index Variable (SIV)	Rating & Description
1. Topography	.70 mesas & Canyons
2. Water, amount & permanence	.70 average site dry 25% of all years
3. Water, distance	.80 distance from escape terrain
4. Water, competition	.50 some big game and livestock
5. Visual obstruction	.70 at distance 50' & height 3' > 60% of object visible
6. Water, distribution	.35 percent of area within mile of H ₂ O
7. Forage areas	.70 forage rating for majority of range
8. Vegetation condition	.75 late seral stage
9. Space--human conflict	.70 medium use, restrictions, no economic change
10. Domestic sheep, distance	.10 usually less than 5 miles

Weighted Indexes

$$\text{Cover(WIC)} = \text{SIV\#1} = 0.70$$

$$\text{Water(WIW)} = \text{SIV\#2}(\text{SIV\#3} + \text{SIV\#4} + \text{SIV\#5} + \text{SIV\#6})/4 = 0.41125$$

$$\text{Forage(WIF)} = (\text{SIV\#3} + \text{SIV\#5} + \text{SIV\#7} + \text{SIV\#8})/4 = .7375$$

$$\text{Human(WIH)} = \text{SIV\#9} = 0.70$$

$$\text{Sheep, Domestic(WIS)} = \text{SIV\#10} = 0.10$$

$$\text{Habitat Suitability Rating(HSR)} = (\text{WIC} + \text{WIW} + \text{WIF} + \text{WIH} + \text{WIS})/5 = 0.53$$

$$\text{Total Square Miles(TSM)} = 145 = 93,000 \text{ acres}$$

$$\text{Occurrence(OCC)} = \text{optimum \# of bighorn sheep per square mile, from literature} = 7.0$$

$$\text{Carrying Capacity} = \text{HSR} \times \text{TSM} \times \text{OCC} = 538 \text{ desert bighorn sheep}$$